THE MORPHOLOGICAL SIGNIFICANCE OF THE JUXTA IN THE MALE GENITALIA OF LEPIDOPTERA.

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In a previous publication[1] relating to the male genitalia of Lepidoptera I did not clearly explain the morphological significance of certain structures situated in the basal region of the valves (gonopophyses) and the penis. These structures, known as the "juxta" in Lepidoptera, form a triangular or quadrate plate on the ventral side of the genitalia just caudad of the ninth sternite. The bases of the valves and occasionally the base of the penis are articulated to the lateral or caudal margins of the juxta. Dr. G. C. Crampton has suggested that this plate is homologous with the "basal plate" of more primitive winged insects in which it is formed by the uniting of the basal segments (coxites) of the gonopophyses. He has further called my attention to the male genitalia of the Tenthredinoid Hymenoptera, which I omitted in my former discussion, which supply a type of genitalic structure intermediate between those of the Ephemerida on the one hand and the Mecoptera, Trichoptera, and Lepidoptera on the other and serve as a basis for determining the homology of the basal plate in these more specialized orders. Through the kindness of Dr. Crampton, Dr. J. C. Bradley, and Dr. J. McDunnough I have been able to examine a series of Ephemerid and Tenthredinid genitalia and compare them with those forms treated in my previous paper. The following is a brief summary of this comparison.

In certain Ephemerida, such as *Leptophlebia* (Fig. 1), the gonopophyses are composed of a pair of distinctly separate basal plates or coxites each bearing a three-segmented gonostyle. The penis is distinctly bipartate and is enclosed laterally by a pair of chitinized sheaths known as the penis valves. In other Ephemerida, *Blasturus* (Fig. 2), the coxites are completely fused forming a chitinous girdle and the gonostyli are composed of but two segments. The penis valves are less distinctly separated from the lateral walls of the penis.

In the generalized Tenthredinoidea as represented by *Megaxyela* (Fig. 3), the basal plate resembles that of *Blasturus* but is

[1] Annals, Ent. Soc. of America, XVII, 275–342, 1924.

smaller and forms a girdle around the bases of the two-segmented gonostyli. Both segments of the gonostyli are larger and heavier than those of the mayflies and the basal segment or basistylus is divided into an inner and outer surface by a fold which Freeborn[2] has termed the "interbasal fold." The penis valves are distinctly separate and the membranous penis is enclosed between them. Although the basal plate shows little evidence of being composed of two elements in adult Hymenoptera its origin from the separate basal portions of the gonopophyses is well described by Zander[3] in his work on the prepupal and pupal development in the genitalia of Vespa. He refers to the basal plate as the "cardo" and describes it as arising as a thickening of the ventral and lateral portion of the bases of the buds which later form the valves or gonopophyses. This occurs in the late larval and early pupal development just after the cocoon is spun and the larva has commenced pupating. From this time on the cardo appears as the basal portion of the valves and is not separated from them by a suture until quite late in the development of the pupa.

In most Mecoptera the condition of the basal plate is similiar to that in the Tenthredinoidea. It is much smaller however and is either fused with the bases of the basistyli as in the Meropidae (Fig. 4), or forms a narrow bridge connecting them as in the Boreidae (Fig. 5). In the Meropidae, Nannachoristidae, and Boreidae there is a small cup-like structure situated at the apex of the terminal segment, (dististylus), of the gonostylus. In my previous publication I called this a "sense organ" and it is possible that it represents the rudiment of the third segment of the gonostylus which exists in a less abbreviated form in many of the mayflies. The penis may consist of a simple chitinized tube as in the Boreidae or may be protected by a pair of valves as in the Meropidae and Panorpodae. These latter are often greatly modified and are fused with the basal plate and basistyli.

In the Trichoptera the basal plate and the gonopophyses offer a great variety of structure and furnish the intermediate forms between the types of structures just described for the Tenthredinoidea and Mecoptera and those of the primitive Lepidoptera. In the Rhyacophilidae and Philopotamidae, (Fig. 6), the basal plate forms a bridge which unites the bases of the gonostyli just

[2] American Journal of Hygiene, IV, 188–212, 1924.

[3] Zeitsch. für Wiss. Zool. LXVII, 461, 1900.

as in the Boreidae. The gonopophyses are heavy, two jointed and have distinct inner and outer surfaces. In the Phryganeidae as illustrated by *Neuronia* (Fig. 8), the basal plate is large and unites the large bases of the gonopophyses much in the same manner as described for the Tenthredinoidea and the Meropidae and Panoridae. The gonopophyses are strikingly like those of the Mecoptera in appearance and structure. In the genus *Phryganea,* however, the basal plate is indistinguishably fused with the basistyli and the dististyli are small and inconspicuous. In the Molannidae (Fig. 7) the basal plate is large and quadrate and unites the bases of a pair of one-jointed gonopophyses. The tendency of the gonopophyses to be single jointed is characteristic of the more specialized Trichoptera. In all adult Trichoptera examined the penis consists of a simple membranous tube protected by a chitinized sheath which in the Lepidoptera is called the ædœagus. There is no evidence of its being bipartate in adult Trichoptera although in some Rhyacophilidae and Phryganeidae the terminal portion is bifid or divided into lobes or processes. More trustworthy evidence of the origin of the penis from two elements is to be found in the work of Zander[4] on the prepupal and pupal development of the genitalia in the Trichoptera and Lepidoptera. This phase of the subject has been exhaustively treated in my previous publication and needs no further discussion here.

The basal plate or juxta of the Lepidoptera is either similar to that described for the Rhyacophilidae and Philopotamidae or for the Phryganeidae and Molannidae. The first or Rhyacophiloid type is to be found in all families of the Micropterygoidea (Fig. 9), with the exception of the Mnesarchaeidae. The second or Molannoid type occurs in the most simple form in the Hepialidae (Fig. 10), and in a more modified condition in the Megalopygidae (Fig. 12). The types of juxta which occur in the more specialized micro-lepidoptera are essentially modifications of those just mentioned, *e.g.,* the Zygaenoidea (as defined by Forbes in "Lepidoptera of New York and Neighboring States," C. U. Ag. Exp. Sta., Mem. 68, 1923) (Fig. 15), are modifications of the Hepialid and Megalopygid types, the Tineoidea (Fig. 11), intermediate between the Hepialid and Micropterygid types, and the Tortricoidae (Fig. 13), and Pyraloidae (Fig. 14), further modifications of the Tineoid type.

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[4] Zeitsch. für Wiss. Zool., LXX, 192–235, 1901. Zeitsch. für Wiss. Zool., LXXIV, 557–615, 1903.

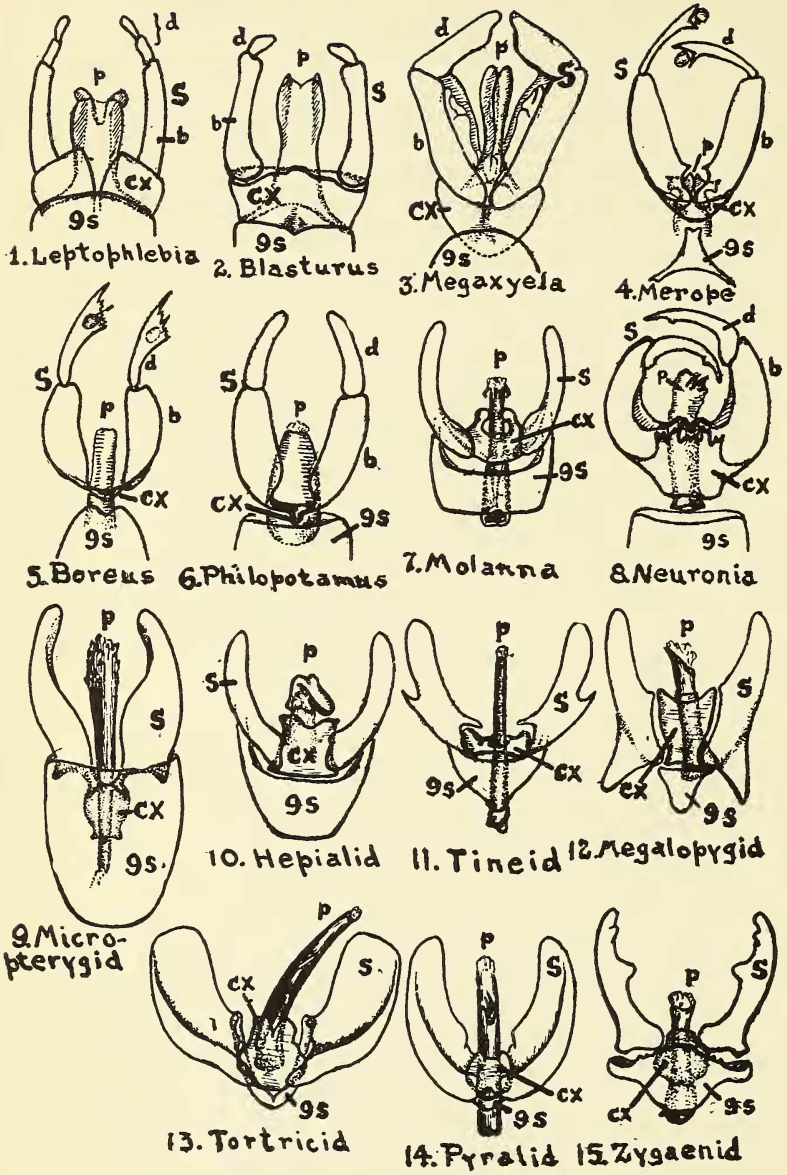
In a few of the families of Lepidoptera the juxta is entirely absent and likewise it is sometimes absent in certain species of families which are characterized by its presence. This loss of the juxta represents a high degree of genitalic specialization. The presence and type of juxta usually indicate the ancestry and relationship of the form considered and generalized tendencies in juxta development are associated with other morphological characters of a primitive nature.

The gonopophyses or valves of the Lepidoptera, like those of the higher Trichoptera, are composed of a single segment, presumably the basistylus. There is no evidence to be found in the valves of adult Lepidoptera or in their development as described by Zander to indicate the presence of the dististylus or a vestige of it. Certain authors have suggested that the " claspers " or " ampullae " which are located on the inner surfaces of the valves of some of the more specialized families represent the rudimentary dististyle. This seems hardly plausible since these structures exist only in the higher forms and are not to be found in any of the ancestral types such as the Micropterygoidea, Hepialoidae, and lower Tineoidea. In the higher Lepidoptera the valves lose their close association with the juxta and become partially or entirely articulated to the caudal margin of the ninth sternite, especially when the juxta is reduced or absent.

Explanation of Plate III.

1. Ephemerid based on *Leptophlebia volitans* McD.
2. Ephemerid based on *Blasturus cupidus* Say.
3. Hymenopteron based on *Megaxyela* sp.
4. Mecopteron based on *Merope tuber* Newm.
5. Mecopteron based on *Boreus brumalis* Ftch.
6. Trichopteron based on *Philopotamus* sp.
7. Trichopteron based on *Molanna angustata* Curt.
8. Trichopteron based on *Neuronia postica* Wlk.
9. Micropterygid based on *Sabatinca chrysargyra* Meyr.
10. Hepialid based on *Hepialus lupulinus* L.
11. Tineid based on *Talaeporia tabulosa* Ritz.
12. Megalopygid based on *Norape tener* Druce.
13. Tortricid based on *Tortrix politana* Hw.
14. Pyralid based on *Pyralis farinalis* Linn.
15. Zygaenid based on *Ctenucha virginica* Charp.

All figures represent ventral view of the structures illustrated.


d
p
S
b
cx
9s
1. Leptophlebia
2. Blasturus
3. Megaxyela
4. Merope
5. Boreus
6. Philopotamus
7. Molanna
8. Neuronia
9. Micro-
pterygid
10. Hepialid
11. Tineid
12. Megalopygid
13. Tortricid
14. Pyralid
15. Zygaenid

ABBREVIATIONS.

9s—9th sternite or vinculum.
cx—coxites, which when fused are called the basal plate or juxta.
S—gonopophysis or gonostylus.
b—basistylus of the gonopophysis.
d—dististylus of the gonopophysis.
p—penis valves or penis sheath called ædœagus in Lepidoptera.

Note on Coccinella oculata Fab.—Many specimens of this ladybeetle were observed by the writer in the District of Columbia, November 19, 1922, on the southern and sunny side of maple trees infested with aphids and scales. A dozen empty pupal skins could be seen on a single tree, especially where the bark had recently been removed. These decorticated spots were lighter and had been selected by the larvae for transformation. On these spots the beetles rested, mostly within two or three feet of the ground. It is evident that the beetles transformed the last of October or in early November; how late should be definitely ascertained, as November is very late in the season for the development of coleopterous larvae to adults and transformation in this month is not likely to occur except when there is exposure to sunlight. This species had never been noticed by the writer in such numbers before in the course of many years' collecting, nor has it been observed in that vicinity since.

An adult under observation at 2:00 P. M., October 22, was white at the time, having just transformed from the pupa. By 2:30 the elytra were slightly infuscated, showing two white spots where the red dots would later appear. By 3:45 this darkness was enhanced, and by 4:00 P. M. the elytra were quite dark although not shining black, the spots still remaining white. By 9:00 A. M., October 23, the elytra were shining black and the spots cream colored, and from this time they began to be faintly tinged with red, until by 1:00 P. M., pale red was distinct. The average temperature was 72° F.—F. H. CHITTENDEN, Washington, D. C.